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PATENT ABSTRACTS OF JAPAN

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(54) ENCIPHERED DATA DECODING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To prevent encipherment-protected data from being illegally used due to an altered decoding support program.

SOLUTION: Receiving a decoding instruction a decoding device 100 temporarily stops operation of a CPU. An address detection part 103 monitors memory accessing of the CPU and acquires a store address Pr of an instruction code that issues the decoding instruction. A cipher authentication part 102 authenticates a cipher key. A decoding support program authentication part 104 acquires the authentication range designation (prepost) from the cipher key calculates a message summary number using a unidirectional hash function about an area covering Pr-pre through Pr+post and compares the calculation result with the message summary number contained in the cipher key to authenticate the correctness of the decoding support program. When this authentication succeeds a data decoding part 101 acquires a cipher decoding key from the cipher key and decodes the enciphered data.

CLAIMS

[Claim(s)]

[Claim 1] An encryption data decoding device comprising:
encryption data decoding device **** which decodes data which was mounted in computer systems and enciphered -- a data decryption means to decode enciphered data based on an encryption key.

An encryption key authentication means which attests that the above-mentioned encryption key is just.

An address detection means to detect a memory address of an instruction code which issued the above-mentioned decoding directions in a decoding support program when decoding directions receive from CPU.

A decoding support program authentication means which attests that the above-mentioned decoding support program is just based on a memory address of the above-mentioned instruction code.

[Claim 2]The encryption data decoding device according to claim 1 which has further an unlawful access prevention means which detects it and takes confrontation measures when a flow of processing is unjustly taken by interruption etc. during execution of the above-mentioned decoding support program.

[Claim 3]The encryption data decoding device according to claim 1 or 2 which verifies whether the above-mentioned decoding support program authentication means has the genuine contents of the code of a predetermined memory address range determined by memory address of the above-mentioned instruction code.

[Claim 4]The encryption data decoding device according to claim 3 which verifies that the contents of the code of the above-mentioned predetermined memory address range are genuine based on a calculation result by a predetermined function of the contents of the code of the above-mentioned predetermined memory address range.

[Claim 5]It is the predetermined encryption data decoding device according to claim 4 made into a tropism function on the other hand about the above-mentioned predetermined function.

[Claim 6]The encryption data decoding device according to claim 4 or 5 with which the above-mentioned encryption key holds a reference value generated from a genuine decoding support programcompares a calculation result by the above-mentioned decoding support program verifying means with the above-mentioned calculation result which the above-mentioned encryption key holdsand the justification of the above-mentioned decoding support program is attested.

[Claim 7]The encryption data decoding device according to claim 6 generated based on a memory address range as which the above-mentioned encryption key held further information which specifies the above-mentioned predetermined memory address rangeand the above-mentioned reference value was specified.

[Claim 8]An encryption data decoding device comprising:
encryption data decoding device **** which decodes data which was mounted in computer systems and enciphered -- a data decryption means to decode enciphered data based on an encryption key.

An address detection means to detect a memory address of an instruction code which transmitted the above-mentioned predetermined information in a decoding support program to the above-mentioned bus when predetermined information is

transmitted to a bus from CPU.

A decoding support program authentication means which attests that the above-mentioned decoding support program is just based on the contents of the above-mentioned decoding support program of a predetermined memory address range determined by memory address of the above-mentioned instruction code.

[Claim 9]An encryption key information generating device which generates encryption key information comprising:

A main part of an encryption key which decodes encryption data.

A calculation result by a predetermined function of a code of the predetermined range of a decoding support program used in order to decode the above-mentioned encryption data.

A signature to the above-mentioned main part of an enciphering key and the above-mentioned calculation result.

[Claim 10]A decoding support program verification method comprising:

A main part of an encryption key which decodes encryption data.

A calculation result by a predetermined function of a code of the predetermined range of a decoding support program used in order to decode the above-mentioned encryption data.

A step which receives encryption key information including a signature to the above-mentioned main part of an enciphering key and the above-mentioned calculation result.

A step which takes out a code developed by memory area corresponding to the above-mentioned predetermined range of a decoding support program used for decoding when decoding encryption data
A step which compares a step which generates a calculation result by the above-mentioned predetermined function of a code by which picking appearance was carried out [above-mentioned] and the generated above-mentioned calculation result with the above-mentioned calculation result in the above-mentioned encryption key information and a step which verifies Shinsei of a decoding support program used for the above-mentioned decoding based on a result of the above-mentioned comparison.

[Claim 11]Computer systems comprising:

A bus.

CPU connected to the above-mentioned bus.

A memory connected to the above-mentioned bus.

Have the authentication device connected to the above-mentioned bus and the above-mentioned authentication device
When decoding directions of encryption data are transmitted via the above-mentioned bus from the above-mentioned CPU
An address detection means to detect a memory address of an instruction code which issued the above-mentioned decoding directions in a decoding support program and an

authentication means which attests that the above-mentioned decoding support program is just based on a memory address of the above-mentioned instruction code.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the art which decodes the enciphered data.

[0002]

[Description of the Prior Art] When applying a cipher system to computer systems and decoding and using conventionally the program and data which were enciphered it is common to execute the decoding program (program which supports decoding calculation and it) which operates on the system (JP3-68024A). By the way in the open computer systems with which specification was exhibited Since the analysis and change of a program are easy by changing the decoding support portion (henceforth a decoding support program) of a decoding program Using decoded data unjustly against the specification of the original decoding program was completed simply and the safety of the whole system had the problem of becoming low. Progress of a coincidence method is remarkable and many cipher systems with powerful encryption strength are proposed. However the problem by the analysis of a decoding program and change is unsolvable however it may adopt a cipher system with high intensity in order not to be dependent on the safety of the cipher system currently used.

[0003] As a proposal which is going to solve this problem the decoding program itself is enciphered a decoding program is decoded only at the time of data decryption a means to do data decryption work is adopted and thereby what makes the analysis and change of a decoding program difficult is known (JP9-6232A). However since decoding a decoding program is also performed by the program after all it does not become essential solution but has only an effect of making some analyses and costs which change takes increase. And since the increasing cost cannot become a serious obstacle if the improved efficiency of a computer in recent years is taken into consideration there is a problem that the analysis and change of a decoding program cannot be prevented effectively. Once it succeeds in change of a decoding program execution of an alteration program cannot be prevented but there is a problem that prevention of appropriation of the decoded data to the purpose which is not intended cannot be performed.

[0004] As a result of CPU's supervising the address which accesses a memory and comparing it with the memory access pattern of the just decoding program expected as a means to prevent change of a decoding program when it is judged that it is

just permit memory access but. When it is judged that it is inaccurate there is a proposal which prevents the unjust data use which is not meant by intercepting memory access (JP5-324483A). However since a program exists in the fixed address position if it is the special small system that the program for apparatus inclusion is supplied by ROM judgment of the justification of a decoding program is possible by supervising the address which CPU accesses but. In a common system since the address with which a program is loaded is determined dynamically there is a problem that a decoding program cannot be judged by the address information to access. Since the access pattern of an unjust judging standard cannot be changed easily it is lacking in extendibility and it is difficult to deal with many encryption data. Therefore in common computer systems this technique has the problem that it cannot be used. [0005] In the Prior art in common computer systems execution of the decoding program which could not attest that it was a just thing by which the decoding program is not changed at the time of decoding but was changed as a result in it could be prevented and it twisted and cut as stated above. For this reason appropriation for the purpose by the decoding program altered and changed which decoded data does not intend cannot be prevented effectively. Therefore the safety of the whole system has the problem of becoming low irrespective of the intensity of a cipher system.

[0006]

[Problem(s) to be Solved by the Invention] Also in the open computer systems with which specification was exhibited this invention enables it to attest the justification of a decoding program at the time of decoding of encryption data and makes it the technical problem for this to prevent appropriation of the decoded data to the purpose by the altered decoding program which is not intended.

[0007]

[Means for Solving the Problem] A data decryption means to decode enciphered data based on an encryption key to an encryption data decoding device which decodes data which was mounted in computer systems and enciphered in order to attain the above-mentioned purpose according to this invention. When decoding directions think of it from CPU as an encryption key authentication means which attests that the above-mentioned encryption key is just. An address detection means to detect a memory address of an instruction code which issued the above-mentioned decoding directions in a decoding support program. He is trying to establish a decoding support program authentication means which attests that the above-mentioned decoding support program is just based on a memory address of the above-mentioned instruction code.

[0008] In this composition the contents of the code of a field appointed beforehand are verified based on a memory address of an instruction code which issued decoding directions in a decoding support program and the justification of a decoding support program can be attested. In this case-izing can be carried out [****] using an address of an instruction code detected even if a decoding support program was

loaded to which field of a memory.

[0009]

[A mode of implementation of an invention] Below an example of this invention is described with reference to drawings. Drawing 1 shows computer systems which decode encryption data using a decoding device of this invention. In this example encryption data is decoded by the decoding device 100 mounted in computer systems and a decoding support program executed with computer systems.

[0010] In drawing 1 CPU 202, the I/O part 203, the decoding device 100, and the memory 205 are connected to the internal bus 201, and computer systems are constituted. CPU 202 is a thing of a general stored program and operates according to directions of a program code which is read via the internal bus 201, interpreted, and a program code stored in the memory 205. A user of a system can use a system as he means by giving directions by a program so that data stored in the I/O part 203 and the memory 205 via the internal bus 201, CPU 202 may be accessed.

[0011] Drawing 2 shows an example of composition of the decoding device 100 of drawing 1. In this figure, the decoding device 100 is constituted including the data decoding section 101, the encryption key authentication section 102, the address detection part 103, the decoding support program authentication section 104, and the unlawful access prevention parts 105. The data decoding section 101 decodes enciphered data based on an encryption key. The encryption key authentication section 102 attests that the encryption key 303 (drawing 5) is just. The address detection part 103 detects a memory address of an instruction code which issued the decoding directions in the decoding support program 301 (drawing 3) when directions of decoding receive from CPU 202. It attests that the decoding support program authentication section 104 has the just decoding support program 301. When a flow of processing is unjustly taken by interruption etc. during execution of the decoding support program 301, the unlawful access prevention parts 105 detect it and take confrontation measures.

[0012] Drawing 3 expresses a data storage situation in a memory when decoding enciphered data. In drawing 3, the decoding support program 301 is a program which uses decode data for the decoding device 100 for the purpose which issued instructions and was intended so that the enciphered data 302 may be decoded and it may store in the decode data storing region 304. The encryption key 303 (refer to drawing 5) is key data required in order to decode encryption data. Stored addresses in the memory 205 of the decoding support program 301, the enciphered data 302, the encryption key 303, and the decode data storing region 304 are packed.

[0013] Drawing 4 is a key map of a memory stored condition of a decoding support program. In drawing 4, from the address p to p_{end} on the memory 205 is a field where the decoding support program 301 is stored. An address with which the decoding directions issue portion 402 which publishes decoding directions is contained in the decoding device 204, and this code is stored in the decoding support program 301 is pr.

A block which was before divided from a pre byte and was back divided from a post byte from the address pr of the decoding directions issue portion 402 is the decoding support program verification block 403. The justification of a decoding support program is judged using a message summary number of the decoding support program verification block 403. pre and post are specified with the encryption key 303 (refer to drawing 5).

[0014]Drawing 5 is a lineblock diagram of the encryption key 303. The encryption key 303 is digital data and comprises the decode key 501 of a codethe message summary number 502 of a decoding support programthe verification area range specification 503and the signature 504 of the whole encryption key.

[0015]In [drawing 6 shows an example of composition of an encryption key generating device which generates the encryption key 303and] drawing 6An encryption key generating device is constituted including the verification range specification part 505the decoding support program input part 506the decode key input part 507the message summary number generation part 508the signature generating part 509and the encryption key outputting part 510. The verification range specification part 505 receives the number of bytes pre and post which specify an address of a decoding instruction codeand a verification block. The message summary number generation part 508 generates a message summary number of a decoding support program in the range specified with the verification range specification part 505. The signature generating part 509 generates a signature to a message summary number generated by the number of bytes prepostand the message summary number generation part 508 of a decode key inputted from the decode key input part 507and verification block specification information. The encryption key outputting part 510 makes one pre of a decode keya message summary numberand block specification information and postand a signatureand outputs them.

[0016]Belowdecoding processing of this example is explained. In this examplethe decoding support program 301 and the decoding device 100 perform decoding processing jointly. Drawing 7 is a flow chart of the decoding support program 301. Drawing 8 is a flow chart showing a flow of processing of the decoding device 100. In drawing 7if execution of the decoding support program 301 is started in order to decode encryption datapretreatment will be performed first (Step 601). In pretreatmentthe encryption data 302 and the encryption key 303 are loaded to the memory 205the field 304 which stores decode data is securedand work which constitutes a memory storing situation as shown in drawing 3and other required pretreatments are performed. Nextstored address [of an encryption key] kstored address [of encryption data] cand appointed stored address d of decode data are given to the decoding device 100. It carries out by specifically outputting kcand d to an I/O Address by which the map was carried out to the decoding device 100 through the internal bus 201 (Step 602). Of courseyou may communicate with the decoding device 100 with an option.

[0017]Then directions are published [performing decoding processing to the decoding device 100 and] (Step 603). An address with which an instruction code equivalent to Step 603 is stored at this time is Pr. Issue of these directions is performed by specifically outputting an indication instruction to an I/O Address by which the map was carried out to the decoding device 100 through the internal bus 201.

[0018]The decoding device 100 which decodes can supervise what kind of access CPU202 is carrying out via the internal bus 201. A memory can be accessed directly without passing CPU (DMA: Direct Memory Access). In addition operation of CPU202 is controlled CPU202 can be maintained at a temporary stopped state if needed or operation can be made to resume.

[0019]In drawing 8 in Step 701 the decoding device 100 which received decoding directions makes operation of CPU202 suspend immediately and reads stored address [of the encryption key 303] k stored address [of the encryption data 302] and appointed stored address d of decode data (Step 701). Thereby the decoding support program 301 will be in a temporary stopped state at Step 603. All accesses to the memory 205 of the following decoding devices 100 use DMA.

[0020]Processing of the decoding device 100 progresses to Step 702. In Step 702 stored address Pr of an instruction code of decoding directions issue is acquired by the surveillance of access to the memory 205 of CPU202.

[0021]Next the encryption key 303 is attested in Step 703. The signature 504 of the whole encryption key is prepared for the encryption key 303 and it is attested by electronic title authentication technology whether it is a just encryption key. A signature authentication key is prepared for a decoding device and specifically it attests using RSA (Rivest-Shamir-Adelman) public-key-encryption art and message abstract generation art using a one-way hash function. Of course you may attest by other methods.

[0022]When attestation goes wrong the encryption key 303 may be altered. The decoding device 100 considers that the encryption key 303 is not just and progresses to Step 705. In Step 705 CPU operation is made to resume and an error code which means in CPU "attestation of an encryption key goes wrong" is returned. An error code is stored in a register which CPU202 can read by specifically accessing an I/O Address by which the map was carried out to the decoding device 100. Of course you may communicate with CPU202 with an option. In the decoding support program 301 which resumed operation it judges that an error occurred in branching of Step 605 error handling is performed at Step 606 and it ends without decoding.

[0023]When it succeeds in attestation of the encryption key 303 in Step 703 processing is advanced to Step 704. In Step 704 the verification range specification 503 is acquired from the encryption key 303 and a message summary number which used a one-way hash function about a field from Pr-pre to Pr+post is computed.

[0024]Then in Step 706 the message summary number 502 of a verification field of a

decoding support program in the encryption key 303 is compared with a message summary number computed at the front step 704. When these are not in agreement the decoding support program 301 which CPU202 is executing means differing from what a publisher of the encryption key 303 meant. The decoding device 100 is regarded as the decoding support program 301 having been altered and progresses to Step 707. In Step 707 operation of CPU202 is made to resume and an error code which means in CPU "attestation of a decoding support program goes wrong" is returned. An error code is stored in a register which CPU202 can read by specifically accessing an I/O Address by which the map was carried out to the decoding device 100. Of course you may communicate with CPU202 with an option. The decoding support program 301 which resumed operation judges that an error occurred in branching of Step 605 of drawing 7 performs error handling at Step 606 and ends it without decoding.

[0025] When it succeeds in attestation of a decoding support program at Step 706 of drawing 8 processing is advanced to Step 708. In Step 708 the decoding device 100 acquires the decode key 501 of a code from the encryption key 303 and performs decoding processing of enciphered data. Specifically from two a decode key of a code and a secret key in which a separate thing is prepared for every device of a decoding device. A decode key of block ciphers such as DES (Data Encryption Standard) is generated data enciphered by block cipher decoder by DMA is read and a decoding result is written out to a decode data field by DMA. Of course the code/decode system of what kind of method may be used.

[0026] After decoding processing finishes data followed and decoded is used for Step 709. It can prevent that after use has data decoded for the purpose which is not intended by eliminating decoded data from the memory 205 if needed used.

[0027] By supervising access to the internal bus 201 of CPU202 the decoding device 100 can detect operation of taking a flow of processing by unjust interruption etc. while the decoding support program 301 is executed by CPU202. When it is detected that a flow of processing was taken unjustly decoding work is stopped at once and data decoded by then is also destroyed by DMA. With this function interference to operation of a program by hardware interrupt can be eliminated and safety improves further.

[0028]

[Effect of the Invention] As explained above this invention prevents appropriation of the decoded data to the purpose by the altered decoding support program which is not intended by checking the justification of a decoding support program at the time of decoding. Thereby the change-proof nature of a decoding support program can be improved and the safety of the system corresponding to encryption strength can be obtained.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is a block diagram showing the composition of the computer systems of the example of this invention.

[Drawing 2] It is a block diagram showing the composition of the decoding device of the above-mentioned example.

[Drawing 3] It is a figure explaining the data storage situation in a memory when decoding the enciphered data.

[Drawing 4] It is a figure which the memory stored condition of a decoding support program shows notionally.

[Drawing 5] It is a figure explaining the composition of an encryption key.

[Drawing 6] It is a block diagram showing the example of composition of the encryption key generating device which generates an encryption key.

[Drawing 7] It is a flow chart explaining operation of a decoding support program.

[Drawing 8] It is a flow chart explaining the flow of processing of a decoding device.

[Description of Notations]

100 Decoding device

101 Data decoding section

102 Address detection part

103 Decoding support program authentication section

104 Unlawful access prevention parts

201 Bus

202 CPU

203 I/O part

205 Memory
